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THE PHILOSOPHY

OF THE

PHYSIOLOGICAL ACTION OF DRUGS.

By J. LEFFINGWELL HATCH, B. Sc., M.D., F.R.M. S. (London).

Visiting Physician to the Harlem Dispensary, Assistant Laryncologist to the New York Nose and Throat Hospital, formerly Lecturer on Bacteriology in the University of Pennsylvania, and late Sanitary Inspector of the Port of Antwerp, Belgium, in the U. S. Marine Hospital Service, etc., etc.

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Physiological Action of Drugs.

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Concerning the time when man first began to speculate as to how the functions are affected by medicaments, and what conclusions were drawn therefrom, history is eloquently silent. Physiology, as we know it, was beyond the mental horizon of the ancients, and only a portion of what we know as physics being then

termed physiology, from the two Greek words φύσις-nature and λογός-discourse: Literally a treatise on the laws of nature.

Just when this word was appropriated for that science which has to do with the study of functions, we are also unable to say with certainty; but until the discovery of the circulation by Harvey, fifteen centuries after Galen had shown that the arteries contained a fluid instead of air,* physiology was as much a form of mysticism as the doctrines of the scholastics, and it seems equally as reasonable to argue as to how many angels can dance on the point of a needle, as to speculate on the oscillation of spirits through empty tubes in our bodies.

It is only at the commencement of the present century that we begin to see the formation of a solid basis for the more intricate superstructure that is to occur, when Bichat elaborated his ingenious

* Galeni Opera, Aer in Arteriis Natura Sanguis contineatur, Cap. VI. A. D. 150.

principle of general anatomy, that he drew from his studies of the anatomy of Vesalius, fragments of truths intermingled with hypotheses like most things of the middle ages, the way to which had been paved by the system of Galen, who in turn drew largely from the Alexandrian school, the first to base its theories upon the anatomy of man, many of whose valuable records perished in that lamentable fire of the library at Alexandria.

These gross studies led many minds to consider what the ultimate minute anatomy might be that constitute these larger tissues. Bacteria had long been described and demonstrated by Leeuwenhoeck, a naturalist of Holland, who worked with small bi-concave lenses, and published the results of his studies at Delphis Batavorum in 1680, in a work entitled *Arcana Naturae Detecta.* But to Schleiden was reserved the honor of discovering the cell, in 1835, which is the basis of our modern histology.

What Schleiden did for vegetable life, Schwann adapted to the animal; and Goodsir, in 1848 in England, and Virchow, in Berlin in 1858, so modified these observations that with a few alterations, such as to the theory of cell-division and origin, they remain practically the same.

When science reached this point, when it recognized that "the cell is really the ultimate morphological element in which there is any manifestation of life,"* when it proved conclusively to itself that the highly deferentiated organism was but the union of mere amebae, and that the special functions of organs all reside in the primitive cell, drawn out solely by necessity, affected by environment, and adapted to the morphology thus produced, then, at this auspicous moment, was science moved with great parturient throes, and Physiology was born.

From this moment many men in

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* Virchow.

many climes have been working steadily in the laboratory, and at the bedside, until we have our physiology of to-day.

Coupled closely with this purely biological science is that of the study of medicines as they affect these functions, and known to us under the title of *physiological action*.

The physiological action of all drugs is traced to either the stimulation or paralysis of some nerve-centre or nerve-ending. How this takes place no one has as yet satisfactorily explained, and the majority of observers are satisfied when they have traced the relation of a drug ingested to some physiological manifestation, and draw at once a conclusion from cause and effect—"*post hoc propter hoc.*"

It is in the interest of philosophic medicine that I offer the following theory, that until it can be refuted or a better one substituted answers the vexed question.

Disease has been defined by many men in many words, but the tersest definition

of all is, "imperfect organization in imperfect action." I like this definition on account of the movement expressed by the word action; but the definition is lame in that we may have disease and not have an imperfect organization, just as we may have a perfect watch that refuses to run but needs only oiling or untangling of the hair-spring to set it going again; so I shall use here the definition of my old master and friend, Prof. GUITERAS, who says, "By disease we mean all those modifications of the normal manifestations of life which impair more or less the adaptability of the individual to the surrounding media."

Now, these modifications of normal manifestations are known as impaired function, and are preceded by changes of structure, themselves being brought about by a primitive obscure alteration of function. Function, of whatever nature, is controlled by the nervous system, so it is through this channel that relief must come when the function is altered.

Medicines, however taken into the system, are absorbed by the circulation and carried to those parts on which they act, producing certain physiological results. All are not in the same state as when ingested, for coming in contact with other elements and compounds, either bring about a direct action or a catalytic one. The blood itself must be affected in its electrical condition by the imbibition of the most benign substance, so that the normal polarity of elements composing the parts through which it flows must be also affected. These effects as they occur from time to time give rise to those phenomena which are termed disposition or feeling. After a particular meal one is in a condition of "bien faisance," because the reaction is a pleasant one, the changes in the blood have produced harmonious changes in polarity wherever they have gone and the organism is in a normal condition.

After another meal there may be un-

easiness or pain; this is due to the changes in the blood producing discordant changes of polarity where they have gone and the organism is in a pathological condition.

Thus our normal functions, as well as our pathological, are due to a change in polarity of juxtaposed atoms. Now this change of polarity entails motion, and this oscilliation of plastidules in cells to satisfy polarity is of the kind we designate vibration. Thus we see that stimulation and paralysis are phenomena produced by undulations. At first sight it may appear paradoxical that two such opposite results can be due to the same cause; but let us pause for a moment and look elsewhere in nature. Take for example the solar spectrum. Here we have a range of different colors all the way from red to violet, and outside of these limits we have heat lines and others that are imperceptible to some of our senses but are capable of producing definite reactions. We may

then, for the sake of comparison, put stimulation in the place of the heat rays, and paralysis beyond the violet in the place of the actinic rays, while between the two there is a large scale where one gradually merges into and blends with the other, stimulation being due to a lesser number of vibrations than paralysis.

In both instances the atoms of the cells (the plastidules) move to and fro, but in the case of stimulation they move farther than in paralysis, and consequently are slower in the former than in the latter, so that in the case of light, when we get beyond a certain number of vibrations we can no longer discern them; likewise when the vibrations that cause stimulation become too numerous we can no longer appreciate them, and paralysis results.

The different cells of the body have a selective affinity, just as the elements elsewhere in nature, so that given a certain cell, a collection of similar cells, and they will be only affected by certain other ele-

ments or combinations of these elements. So, also, certain of these elements and compounds will act more forcibly than others of the same group because the affinity between them and the cells is greater. This affinity, like electrical attraction elsewhere in nature, is due to opposite polarity or a forced dissimilar polarity by means of conduction. It is passed on from cell to cell of a like polarity and causes naturally a vibratory movement, *and it is the effect of this movement that we designate physiological action*, the intensity of which depends upon the amplitude of the vibrations engendered.

Let us take as an illustration, the physiological action of opium upon the respiration. It has been found by experiment that death from opium, in the majority of cases, is by failure of the respiration. If the pneumogastrics are cut and the drug then administered, death from failure of respiration occurs and must be due to its action upon the respiratory centre in the

medulla. Now, why does opium act upon this centre rather than upon the pneumogastrics; or, if it does act upon them at all, why is it not as intense in the one case as in the other? The answer lies in the proposition just laid down, that the selective affinity between the cells forming the respiratory centre in the medulla and opium, or rather the changed electrical condition of the elements composing the blood after the ingestion of opium, is greater than the affinity between the cells of the pneumogastrics and the same. The attraction is so great and the wave caused by the resulting vibrations so intense and rapid that paralysis ensues with resulting suspension of respiration.

The illustration of this single drug, I think, will be sufficient to make my theory clear. I could bring before you the entire pharmacopeia, but it would be to merely repeat the above example. The principle has to do alone with one of the primeordial factors of cell-life, namely the electrical condition.

We are but yet on the threshold of the knowledge of the ways and means of electricity and its relation to life, and perhaps in the dim uncertain light of the present we are overlooking great factors, on account of their seeming simplicity, that to the clear sight of the future seers, will seem as plain as the principles of the telephone and phonograph to us, after an Edison shall have led them over the "*pons asinorum.*"

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